

# New Hampshire Volunteer Lake Assessment Program

## 2003 Interim Report for Gould Pond Hillsboro



NHDES  
Water Division  
Watershed Management Bureau  
29 Hazen Drive  
Concord, NH 03301



# OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **GOULD POND, HILLSBORO**, the program coordinators have made the following observations and recommendations:

Walter Henderson, a DES Biologist and Hillsboro resident, sampled Gould Pond for the association this summer. We want to thank Walter for being so willing to help over the years! We would also like to encourage the association to recruit additional volunteers to help with the sampling. Please contact the V LAP coordinator if you would like suggestions on how to recruit additional volunteers.

## **FIGURE INTERPRETATION**

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 mg/m<sup>3</sup>.**

The current year data (the top graph) show that the chlorophyll-a concentration **remained stable** from June to July, and then **increased** from July to September. *(Please note that the pond was not sampled in August. The September sampling event was conducted on September 2).* The chlorophyll-a concentration in June and July was **less than** the state mean, while the concentration in September was **greater than** the state mean.

The historical data (the bottom graph) show that the 2003 chlorophyll-a mean is ***approximately equal to*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a variable*** in-lake chlorophyll-a trend. Specifically, the mean annual chlorophyll concentration has ***fluctuated***, but has *not continually increased or continually decreased*, since monitoring began in 1989. After 10 consecutive years of sample collection, we will conduct a statistical analysis of the historic data to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began. (Please note that the pond was not sampled in 2000.)

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase with an increase in nonpoint sources of phosphorus loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Therefore, it is extremely important for volunteer monitors to continually educate residents about how activities within the watershed can affect phosphorus loading and lake/pond quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

The current year data (the top graph) show that the in-lake transparency ***increased*** from June to July, and then ***decreased*** from July to September. The transparency on each sampling event was ***less than*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a slightly increasing*** trend for in-lake transparency, meaning that the transparency has ***slightly improved*** since monitoring began in 1989. As discussed previously, after 10

consecutive years of sample collection, we will conduct a statistical analysis of the historic data to objectively determine if there has been a significant change in the annual mean transparency since monitoring began.

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration **decreased** from June to July, and then **increased** from July to September. The phosphorus concentration in June and September was **slightly greater than** the state median, while the concentration was **slightly less than** the state median in July.

The historical data show that the 2003 mean epilimnetic phosphorus concentration is **approximately equal to** the state median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration **increased** from June to July, and then **remained stable** from July to September. The phosphorus concentration on each event was **greater than** the state median.

The historical data show that the 2003 mean hypolimnetic phosphorus concentration is ***much greater than*** the state median.

Overall, visual inspection of the historical data trend line for the epilimnion shows a ***relatively stable*** phosphorus trend since 1991.

Overall, visual inspection of the historical data trend line for the hypolimnion shows a ***variable*** phosphorus trend, which means that the concentration has ***fluctuated*** in the hypolimnion since monitoring began.

It is also important to point out that the phosphorus concentration in the hypolimnion has typically been ***much greater than*** the phosphorus concentration in the epilimnion. This data indicates that ***internal phosphorus loading*** is occurring in the hypolimnion. (Please refer to the discussion of Table 9 and 10 for a detailed explanation of internal total phosphorus loading.)

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

#### **TABLE INTERPRETATION**

##### **➤ Table 2: Phytoplankton**

Table 2 (Appendix B) lists the current and historic phytoplankton species observed in the lake/pond.

The dominant phytoplankton species observed on the June sampling event were ***Chrysosphaerella, Mallomonas, and Dinobryon (which are all golden-brown algae).***

The dominant phytoplankton species observed on the July sampling event were ***Chrysosphaerella (a golden-brown algae), Anabaena (a cyanobacteria), and Peridinium (a dinoflagellate).***

Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

An overabundance of cyanobacteria (previously referred to as blue-green algae) indicates that there may be an excessive total phosphorus concentration in the lake/pond, or that the ecology is out of balance. Some species of cyanobacteria, including *Anabaena*, can be toxic to livestock, pets, wildlife, and humans.

Cyanobacteria can reach nuisance levels when excessive nutrients and favorable environmental conditions occur. During September of 2003, a few lakes and ponds in the southern portion of the state experienced cyanobacteria blooms. This was likely due to nutrient loading to these waterbodies. As mentioned previously, many weeks during the Spring and Summer of 2003 were rainy, which likely resulted in a large amount of nutrient loading to surface waters.

The presence of cyanobacteria serves as a reminder of the lake's/pond's delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading into the lake/pond by eliminating fertilizer use on lawns, keeping the lake/pond shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake/pond in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria (blue-green algae) have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to "pile" cyanobacteria into scums that accumulate in one section of the lake/pond. If a fall bloom occurs, please contact the VLAP Coordinator.

➤ **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.5**, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean pH at the deep spot this season ranged from **5.91** in the hypolimnion to **6.61** in the epilimnion, which means that the water is ***slightly acidic***. When organic matter is decomposed near the lake bottom, acidic by-products are produced, which likely explains the lower pH (meaning higher acidity) in the hypolimnion.

Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 (Appendix B) presents the current year and historic epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. The mean ANC value for New Hampshire's lakes and ponds is **6.7 mg/L**, which indicates that many lakes and ponds in the state are "highly sensitive" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) continues to remain ***less than*** the state mean. Specifically, the mean ANC this season was **5.03 mg/L** which indicates that the lake/pond is ***highly sensitive*** to acidic inputs (such as acid precipitation).

➤ **Table 6: Conductivity**

Table 6 (Appendix B) presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. The mean conductivity value for New Hampshire's lakes and ponds is **62.1 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The conductivity has ***increased slightly*** at the deep spot of the lake/pond since monitoring began. In addition, the conductivity in **Beaver Glen Brook** has ***increased greatly*** since monitoring began.

Typically, sources of increased conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock

areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity.

We recommend that your monitoring group conduct a stream survey and storm event sampling along **Beaver Glen Brook** so that we can determine what may be causing the elevated conductivity levels.

*For a detailed explanation on how to conduct rain event and stream surveys, please refer to the 2002 VLAP Annual Report “Special Topic Article”, or contact the VLAP Coordinator.*

➤ **Table 8: Total Phosphorus**

Table 8 (Appendix B) presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae’s ability to grow and reproduce. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The total phosphorus concentration was **very high** in **Beaver Glen Brook** this season. This station has had a history of **elevated and fluctuating** total phosphorus concentrations. We recommend that your monitoring group conduct a stream survey and storm event sampling along this inlet so that we can determine what may be causing the elevated phosphorus levels.

*For a detailed explanation on how to conduct rain event and stream surveys, please refer to the 2002 VLAP Annual Report “Special Topic Article”, or contact the VLAP Coordinator.*

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2003 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

*(Please note that a dissolved oxygen and temperature profile was taken on the June and July sampling events. However, a profile was not taken on the September sampling event due to an equipment malfunction.)*



The dissolved oxygen concentration was greater than **100 percent** saturation at **0.1, 1.0, and 2.0 meters** on the **July** sampling event. Wave action from wind can also dissolve atmospheric oxygen into the upper layers of the water column. Layers of algae can also raise the dissolved oxygen in the water column, since oxygen is a by-product of photosynthesis.

The dissolved oxygen concentration was **low in the hypolimnion** at the deep spot of the lake/pond on the June and July sampling events. As stratified lakes/ponds age, oxygen becomes **depleted** in the hypolimnion (the lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake/pond where the water meets the sediment.

During this season, and many past sampling seasons the lake/pond has had a lower dissolved oxygen concentration and a higher total phosphorus concentration in the hypolimnion (the lower layer) than in the epilimnion (the upper layer). These data suggest that the process of **internal phosphorus loading** is occurring in the lake/pond. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion (**as it was this season and in many past seasons**), the phosphorus that is normally bound up with metals in the sediment may be re-released into the water column. Depleted oxygen concentration in the hypolimnion of thermally stratified lakes/ponds typically occurs as the summer progresses.

Internal phosphorus loading may explain why the phosphorus concentration in the hypolimnion is **greater** than the phosphorus concentration in epilimnion. Since an internal source of phosphorus in the lake/pond may be present, it is even more important that watershed residents act proactively to minimize external phosphorus loading from the watershed.

➤ **Table 11: Turbidity**

Table 11 (Appendix B) lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

The turbidity in the **Beaver Glen Brook** sample on the July and September sampling event was **slightly elevated**, which suggests that the stream bottom may have been disturbed while sampling or that erosion is occurring in this portion of the watershed.

## OBSERVATIONS AND RECOMMENDATIONS

---

2003

When the stream bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting samples in the inlets, please be sure to sample where there the stream is flowing and where the stream is deep enough to collect a “clean” sample.

If you suspect that erosion is occurring in this portion of the watershed, we recommend that your monitoring group conduct stream surveys and storm event sampling along this inlet. This additional sampling may allow us to determine what is causing the elevated levels of turbidity.

### **NOTES**

- **Monitor’s Note (7/31/03):** Observed a tame Canada Goose; Launch Brook and Beaver Glen Brook were not flowing; no sample was taken.  
**(9/2/03):** DO Meter batteries dead; no oxygen profile taken.
- **Biologist’s Note (6/20/03):** Beaver Glen Brook sample is tea colored.  
**(7/31/03):** The phosphorous level at the hypolimnion was found to be elevated.  
**(9/2/03):** The total phosphorous level at Beaver Glen Brook was high. In addition, the total phosphorous level at the hypolimnion was elevated, which could suggest internal loading.

### **USEFUL RESOURCES**

*Acid Deposition Impacting New Hampshire’s Ecosystems, ARD-32, NHDES Fact Sheet, (603) 271-3505, or [www.des.state.nh.us/factsheets/ard/ard-32.htm](http://www.des.state.nh.us/factsheets/ard/ard-32.htm).*

*Aquarium Plants and Animals: Don’t leave them stranded.* Informational pamphlet sponsored by NH Fish and Game, Aquaculture Education and Research Center, and NHDES (603) 271-3505.

*Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, NHDES-WD 97-8, NHDES Booklet, (603) 271-3503.*

*A Boater’s Guide to Cleaner Water, NHDES pamphlet, (603) 271-3503.*

*Camp Road Maintenance Manual: A Guide for Landowners.* KennebecSoil and Water Conservation District, 1992, (207) 287-3901.

*Comprehensive Shoreland Protection Act, RSA 483-B, WD-SP-5, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/sp/sp-5.htm](http://www.des.state.nh.us/factsheets/sp/sp-5.htm).*

*Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or [www.des.state.nh.us/factsheets/wmb/wmb-10.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-10.htm).*

*Erosion Control for Construction in the Protected Shoreland Buffer Zone, WD-SP-1, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/sp/sp-1.htm](http://www.des.state.nh.us/factsheets/sp/sp-1.htm).*

*Impacts of Development Upon Stormwater Runoff, WD-WQE-7, NHDES Fact Sheet, (603) 271-3503, or [www.des.state.nh.us/factsheets/wqe/wqe-7.htm](http://www.des.state.nh.us/factsheets/wqe/wqe-7.htm).*

*Iron Bacteria in Surface Water, WD-BB-18, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/bb/bb-18.htm](http://www.des.state.nh.us/factsheets/bb/bb-18.htm).*

*Is it Safe to Eat the Fish We Catch? Mercury and Other Pollutants in Fish, NH Department of Health and Human Services pamphlet, 1-800-852-3345, ext. 4664.*

*Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, WD-BB-9, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/bb/bb-9.htm](http://www.des.state.nh.us/factsheets/bb/bb-9.htm).*

*Management of Canada Geese in Suburban Areas: A Guide to the Basics, Draft Report, NJ Department of Environmental Protection Division of Watershed Management, March 2001, [www.state.nj.us/dep/watershedmgt/DOCS/BMP\\_DOCS/Goosedraft.pdf](http://www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf).*

*Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/sp/sp-2.htm](http://www.des.state.nh.us/factsheets/sp/sp-2.htm).*

*Road Salt and Water Quality, WD-WMB-4, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/wmb/wmb-4.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-4.htm).*

*Sand Dumping - Beach Construction, WD-BB-15, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/bb/bb-15.htm](http://www.des.state.nh.us/factsheets/bb/bb-15.htm).*

*Swimmers Itch, WD-BB-2, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/bb/bb-2.htm](http://www.des.state.nh.us/factsheets/bb/bb-2.htm).*

*Through the Looking Glass: A Field Guide to Aquatic Plants. North American Lake Management Society, 1988, (608) 233-2836 or [www.nalms.org](http://www.nalms.org).*

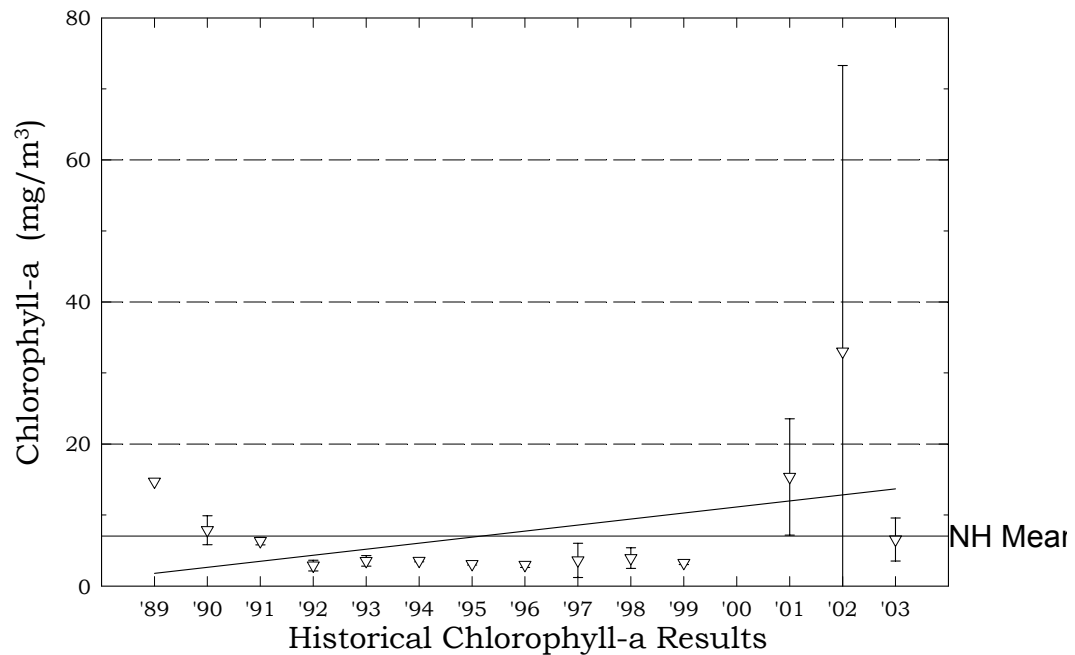
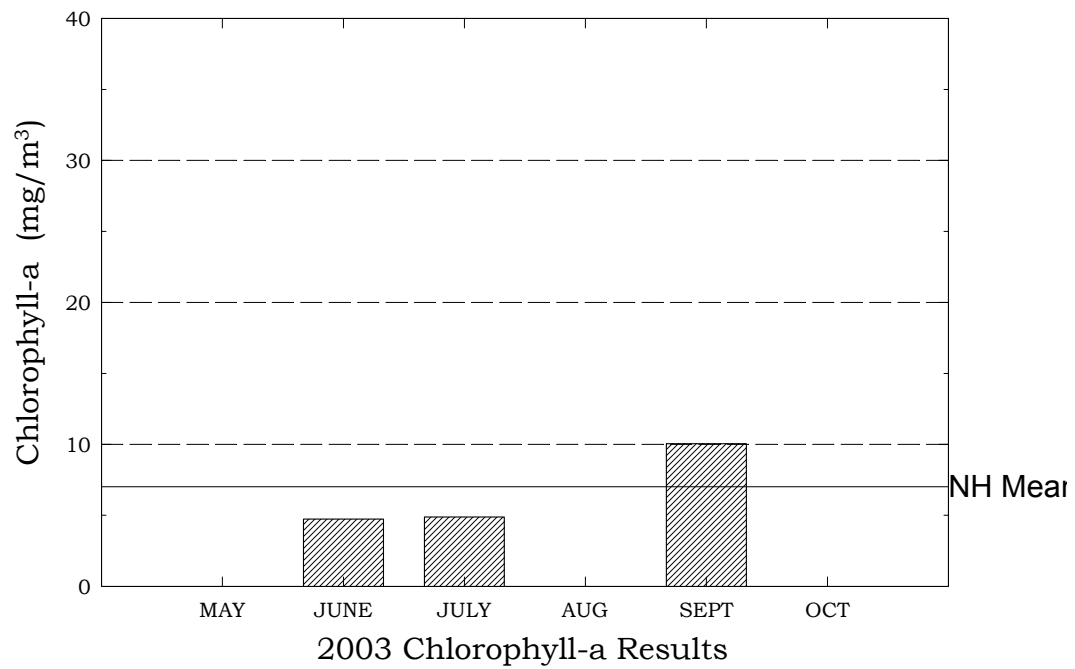
*Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/bb/bb-4.htm](http://www.des.state.nh.us/factsheets/bb/bb-4.htm).*

# APPENDIX A

## GRAPHS

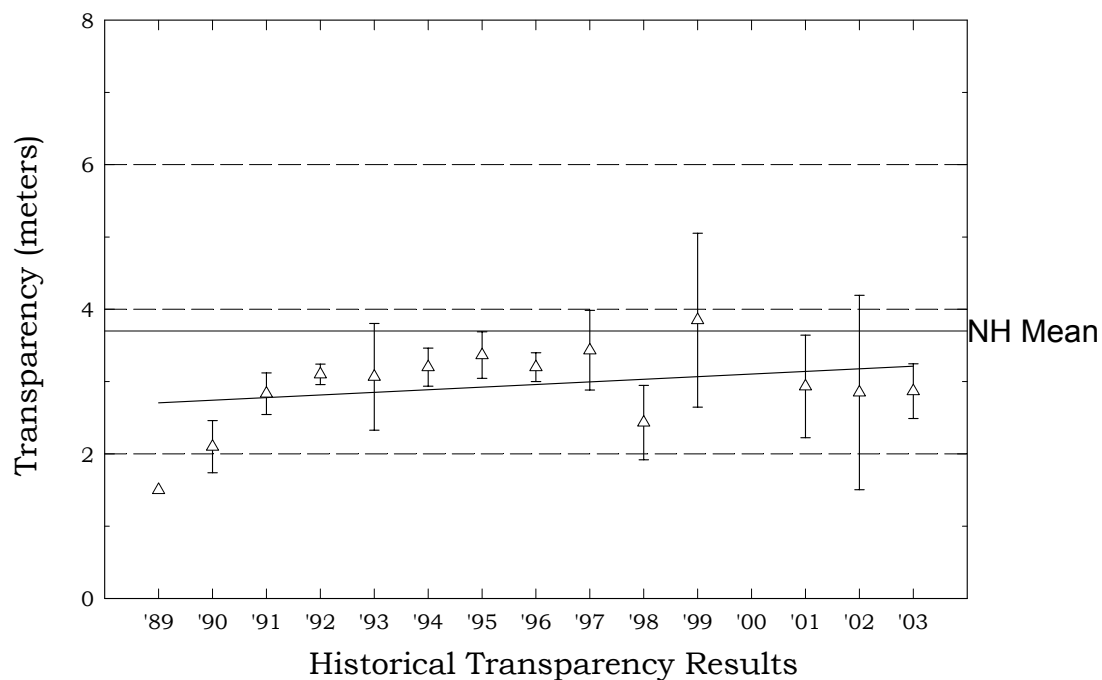
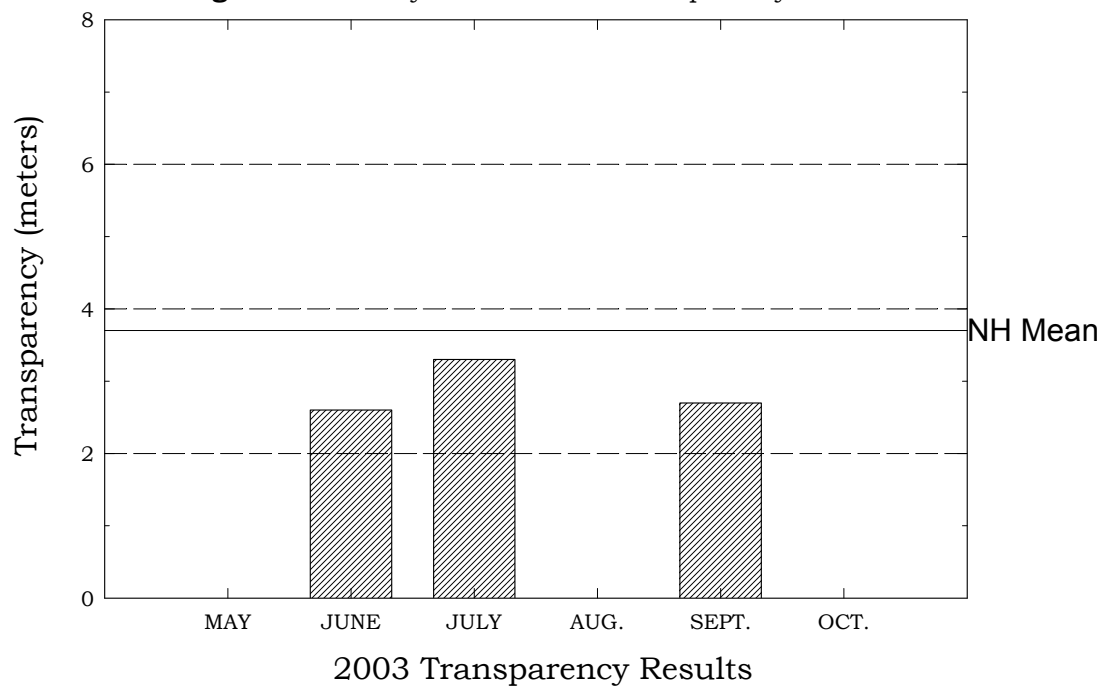
# Gould Pond, Hillsboro

**Figure 1.** Monthly and Historical Chlorophyll-a Results



## Gould Pond, Hillsboro

**Figure 2.** Monthly and Historical Transparency Results



## Gould Pond, Hillsboro

**Figure 3.** Monthly and Historical Total Phosphorus Data.

